Alternative tools for financial evaluation of forestry

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THE HOME-GROWN HOMES PROJECT

05 Economic aspects of woodland creation for timber production

Alternative tools for financial evaluation of forestry

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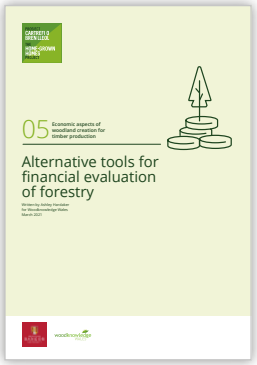

Guidance

This document is part of a series of *guidance notes* aiming to provide practical information for farmers and other landowners interested in investing in forestry. It is designed to help develop a first understanding of economic evaluation of afforestation projects. As such it introduces the basic steps involved in the assessment of such projects to allow some preliminary due diligence when considering an investment in forestry. This does not replace a full assessment and advice by a chartered forest manager.

There are six documents in this series

01 Financial evaluation of afforestation projects - basic steps

02 Evaluating the financial costs of forestry

03 Revenue from forestry enterprises

04 Accounting for time

05 **Alternative tools for financial evaluation of forestry**

06 Incorporating uncertainty and risk into forestry financial evaluations

How to assess if an investment into forestry is likely to be profitable has been addressed in other guidance notes of this *series*.

In this guidance note we introduce some additional tools that can be used to address the following questions farmers or other landowners may want to answer when making such an investment decision:

- How to compare the profitability of a forestry enterprise with agriculture?
- Would it be more profitable changing to a forestry enterprise than continuing with agricultural production on a particular area of land?

Comparing profitability of forestry with agriculture

Once a financial evaluation of an afforestation project has been undertaken and shows that it would be a financially acceptable investment (see *Financial Evaluation of Afforestation Projects - Basic Steps*), landowners may want to compare its financial returns with the returns they are receiving from the current land use (i.e., agricultural production). The very different cash flow profiles of agriculture and forestry raise a particular challenge in comparing the two enterprises.

Equivalent annual value

'Net margins' from agricultural enterprises represent annual cash flows, where revenues and costs are received each year. 'Net present values' are more appropriate to evaluate a forestry enterprise as they represent the sum of the discounted future cash flows (see *Financial Evaluation of Afforestation Projects - Basic Steps*), which extend over a long period of time with large negative cash spikes in the first few years followed by a large positive cash spike in a later year. However, these two figures are not equivalent. Comparing the net margin of an agricultural enterprise with the net present value of a forestry enterprise would incorrectly favour the forestry enterprise as the latter will be much larger than the former, because of the way it is calculated. To provide a more realistic basis for comparison, a simple additional calculation should be included in the discounted cash flow analysis. This provides the required information on the average annual incomes or *equivalent annual value* (EAV) of a forestry investment (Box 1).

Box 1: Calculating the equivalent annual value

The equivalent annual value (EAV) is the average annual cash flow over the lifetime of an investment. It is calculated using the net present value (NPV) of the investment and the same discount rate used to calculate the net present value of the investment (see Financial Evaluation of Afforestation Projects - Basic Steps) based on the following formula:

$$\text{EQUIVALENT ANNUAL VALUE} = \frac{(\text{discount rate} \times \text{NPV})}{1 - (1+\text{discount rate})^{-\text{length of rotation}}}$$

When using this formula, the chosen discount rate needs to be expressed as a decimal number, e.g., a discount rate of 3% would be expressed as 0.03..

The *equivalent annual values* of the exemplar afforestation options of upland and lowland conifer plantations are shown in Table 1. These are calculated using the formula outlined in Box 1 and the net present values used previously (see *Financial Evaluation of Afforestation Projects - Basic Steps* and *Revenue from Forestry Enterprises*). The predicted equivalent annual values are based on timber revenues only and revenues from timber and carbon credits:

- Upland conifer option: £113 per hectare per year from timber alone or £166 per hectare per year when revenues from carbon credits are included.
- Lowland conifer option: £137 per hectare per year from timber alone or £191 per hectare per year when revenues from carbon credits are included.

The *equivalent annual values* would typically be compared with the annual net margin (£ per hectare) of the current agricultural enterprise. These would be derived from actual farm accounts. For the purpose of this example some comparable annual agricultural incomes are shown in Table 2.

Table 1: Equivalent annual value (£ per hectare per year) of the exemplar afforestation options at a discount rate of 3%

Option	Rotation length (years)	Equivalent annual value (£ per hectare per year)	
		Timber	Timber and carbon
Upland conifer	50	$\frac{0.03 \times 2{,}899}{1-(1+0.03)^{-50}} = 113$	$\frac{0.03 \times 4{,}265}{1-(1+0.03)^{-50}} = 166$
Lowland conifer	40	$\frac{0.03 \times 3{,}178}{1-(1+0.03)^{-40}} = 137$	$\frac{0.03 \times 4{,}415}{1-(1+0.03)^{-40}} = 191$

Table 2: Comparable annual agricultural incomes (average enterprise performance) based on figures from the *John Nix Pocketbook for Farm Management*

Option	Comparable agricultural enterprise	A Gross margin (£ per hectare)	B Basic payment (£ per hectare)	C Fixed costs (£ per hectare)	Net margin (£ per hectare) A + B - C
Upland conifer	Hill sheep Hill suckler cows	180 380	200 200	240 240	140 340
Lowland conifer	Lowland sheep Lowland suckler cows	550 590	200 200	470 470	280 320

Comparing the *equivalent annual values* in Table 1 with the agricultural incomes in Table 2 suggests that for our example sites:

For the upland conifer option...

- When revenues from both timber and carbon credits are included, the equivalent annual incomes would be higher than the annual incomes from a *hill sheep enterprise* but lower than the annual returns from a *hill suckler cow enterprise.*
- When only timber revenues are included the equivalent annual returns are lower than the annual incomes from a *hill sheep enterprise*.

For the lowland conifer option...

- The equivalent annual incomes would be lower than the annual returns from both a *lowland sheep enterprise* and a *lowland suckler cow enterprise*.

In this hypothetical example, for a *lowland farmer* continuing with livestock grazing with both sheep and cattle would likely be more profitable than investing in this particular *lowland conifer afforestation option*. For an *upland farmer* continuing with grazing cattle would likely be more profitable than investing in this particular *upland conifer option*. However, investing in the upland conifer options is likely to be more profitable for the upland farmer than continuing with grazing sheep.

Change to a forestry enterprise or continue with agriculture?

In *Evaluating the Financial Costs of Forestry* we introduced the concept of *implicit costs*. These are not typically included in the financial evaluation tools presented in this series as they do not explicitly include any monetary exchange. However, implicit costs have an important bearing on whether a forestry investment is a good use of resources. The main implicit costs of importance to decision makers such as farmers, landowners and investors are *opportunity costs* (see *Accounting for Time*). These are the value of a resource in its alternative use or the net value of the output that is forgone when a factor of production (e.g., land) is moved from one course of action to another. In the context of the type of forestry investment covered in this guidance note, the alternative will be the use of land for agricultural production. The opportunity cost of land is the most common and likely to be the most important implicit cost. However, there may be circumstances where opportunity costs relate to materials, labour and capital. For more information see *Elements of Cost-Benefit Analysis for Forestry Investments* or *Cost-Benefit Analysis. Financial and Economic Appraisal Using Spreadsheets*.

Benefit-cost ratio

In addition to the *discounted cash flow* (DCF) model of cost-benefit analysis (see guidance notes 01-04) the *benefit-cost ratio* (BCR) model can be used to incorporate implicit costs alongside explicit financial revenues and costs[1].

This model calculates the ratio of discounted benefits to the discounted costs (Box 2). Similar to *discounted cash flow analysis* and calculation of *net present values* and *equivalent annual values*, the value of future benefits and costs are all discounted to their present value with *benefit-cost ratio*. However, *discounted cash flow analysis* does not account for the value of what is 'lost' when switching between two land use options. *Benefit-cost ratio* achieves the comparison between forestry and alternative (agriculture) enterprise through the inclusion of *opportunity costs* (i.e., what is lost) in one single calculation.

Much of the information used to calculate *benefit-cost ratios* is the same as calculating net present values using *discounted cash flow analysis* including:

- The amount and timing of all financial cash flows directly related to the forestry enterprise.
- An appropriate discount rate (see *Accounting for Time*).

In addition to this information the opportunity cost of afforestation project inputs (i.e., land, materials, labour and capital) is used to calculate *benefit-cost ratios*. The opportunity cost of each of these inputs is the value of the output they would have produced in their alternative use in a world without the afforestation project.

Box 2: Calculating the benefit-cost ratio

The benefit-cost ratio (BCR) of a forestry investment is calculated using the following formula:

$$\text{BENEFIT – COST RATIO} = \frac{\text{Sum of present value of future benefits}}{\text{Sum of present value of future costs}}$$

If BCR > 1 the benefits of the forestry investment exceed the costs. Changing to the forestry enterprise on a particular area of land would be more profitable than continuing with its current use.

If BCR = 1 the benefits of the change equal the costs. There is no additional financial benefit in changing to a forestry enterprise.

If BCR < 1 the costs of the forestry option exceed the benefits. Changing to the forestry enterprise on a particular area of land would be less profitable than continuing with its current use.
For more information see *Basic Concepts in Forest Valuation* and *Investment Analysis or Forestry Economics*.

[1] See *guidance note 02* for an overview of how to estimate the financial costs of a forestry investment and see *guidance note 03* for an overview of how to estimate the financial returns of an afforestation project.

Box 3: Calculating present value of recurring income

The present value (PV) of a recurring income or annuity is calculated using the following formula:

$$\text{PV OF RECURRING INCOME} = \text{ANNUITY} \times \frac{1 - \left(\frac{1}{(1+\text{discount rate})^{\text{number of years}}}\right)}{\text{Discount rate}}$$

When using this formula, the chosen discount rate needs to be expressed as a decimal number, e.g., a discount rate of 3% would be expressed as 0.03.

Calculating the *benefit-cost ratio*s for the two example afforestation projects used above (see *Financial Evaluation of Afforestation projects - Basic Steps*), we will focus on the opportunity cost of land as this is likely to be the most common and important implicit cost.

The current use of land earmarked for afforestation is agriculture. Hence, the opportunity cost is the future stream of net income[2] that would be generated from agricultural production over the length of the forestry investment. This is estimated using the annual net margin for the agricultural enterprise[3] and the formula for calculating the *present value* of a recurring income (Box 3).

The benefit-cost ratios for the example upland and lowland afforestation options (see *Financial Evaluation of Afforestation Projects - Basic Steps*) are shown in Table 3. The *present value* of costs, grant payments and timber incomes and the present value of carbon sales are taken from the discounted cash flow previously established for these examples (see *Financial Evaluation of Afforestation Projects - Basic Steps* and *Revenue from Forestry Enterprises*). The assumed land opportunity costs from forgone agricultural incomes are for sheep grazing.

Table 3: Benefit-cost ratio of the two example afforestation options using a discount rate of 3%

Year	Description	Upland conifer option		Lowland conifer option	
		Costs	Benefits	Costs	Benefits
1-4	Fencing, ground prep, planting, weeding and beating up	8,675		8,675	
1-40	Land opportunity costs (agricultural incomes foregone)			6,472	
1-50	Land opportunity costs (agricultural incomes foregone)	3,602			
1-12	Fencing, planting, maintenance and premium payment[1]		9,194		9,194
2	Revenues from carbon sales[2]		1,366		1,237
40	Timber revenues from maincrop (lowland option)[1]				2,658
50	Timber revenues from maincrop (upland option)[1]		2,378		
Summary		**Upland conifer option**		**Lowland conifer option**	
Total present value of benefits		12,938		13,089	
Total present value of costs		12,277		15,147	
Benefit-cost ratio		1.05		0.86	

[1] The present value of costs and grant payments are taken from the discounted cash flow in Guidance note one. For an explanation of these costs refer to that note.

[2] The present value of revenues is calculated using the formula: PV = [value of future revenue or cost] / [(1 + discount rate expressed as decimal number) ^ year into the future].

Practical Guidance & Advice

In this guidance note we have introduced some alternative tools that can be used when evaluating a decision to invest in an afforestation project. These tools allow landowners to compare forestry with agriculture and to include loss of agricultural incomes in financial evaluations.

We hope that this will help you undertake some preliminary due diligence when considering whether to adopt a forestry enterprise or invest in an afforestation project. Before making the final decision we recommend seeking further advice and guidance from a *forest manager or agent*.

You can find more detailed information on financial evaluations of forestry investments *here*:

01 Financial Evaluation of Afforestation Projects - Basic Steps
02 Evaluating the Financial Costs of Forestry
03 Revenue from Forestry Enterprises
04 Accounting for Time
05 Alternative Tools for Financial Evaluation of Forestry
06 Incorporating Uncertainty and Risk

Technical Information

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About the author
Ashley Hardaker is an interdisciplinary researcher at Bangor University interested in decision analysis in relation to land use, forestry, agroforestry and agricultural systems. He is particularly interested in research to inform decision making surrounding woodland creation in agricultural systems and how they can be designed to deliver public and private economic benefits. He engages with a range of research disciplines including ecosystem services, GIS, economics and operations research. The author is grateful for contributions to these briefing notes from Prof. John Healey of Bangor University

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